



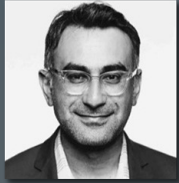
First Look at a 5-year Strategic Roadmap

12:30 – 2:30 pm September 19th, 2022

RE+ 2022 Room 208 A

An EERE collaboration between SETO & WETO

i2x@ee.doe.gov | energy.gov/i2x



Presenter

Ammar Qusaibaty

Technology Manager
Solar Energy Technologies Office

AGENDA

1

**i2X Program
Overview**
(10 min)

2

**5-Year Strategic
Roadmap Overview**
(30 min)

3

**Interactive
Discussion**
(45-60 min)

4

**Closing &
Networking**
(15 min)

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Presenter

Michele Boyd

Program Manager
Solar Energy Technologies Office

1

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Executive Order on Climate and Equity

- **Establishes the Administration's climate goals:**

A carbon-free electricity sector by 2035 and a decarbonized economy by 2050.

- **Establishes the Justice40 Initiative:** Sets a goal that 40 percent of the overall benefits of certain Federal Investments (including clean energy and energy efficiency) are to flow to disadvantaged communities.

- **Prioritizes climate in foreign policy and national security.**

- **Requires a government-wide approach to climate**

- **Requires the Federal agencies to use authorities, public lands/waters, and financial programs to catalyze clean energy deployment**

- **Proposes a Civilian Climate Corps Initiative**

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[Administration](#) [Priorities](#) [COVID Plan](#)

BRIEFING ROOM

Executive Order on Tackling the Climate Crisis at Home and Abroad

JANUARY 27, 2021 • PRESIDENTIAL ACTIONS

The United States and the world face a profound climate crisis. We have a narrow moment to pursue action at home and abroad in order to avoid the most catastrophic impacts of that crisis and to seize the opportunity that tackling climate change presents. Domestic action must go hand in hand with United States international leadership, aimed at significantly enhancing global action. Together, we must listen to science and meet the moment.

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:



Solar Energy Technologies Office (SETO) Overview

MISSION

We accelerate the **advancement** and **deployment of solar technology** in support of an **equitable** transition to a **decarbonized economy no later than 2050**, starting with a decarbonized power sector by 2035.

WHAT WE DO

Drive innovation in technology and soft cost reduction to make solar **affordable** and **accessible** for all Americans

Enable solar to support the **reliability, resilience, and security** of the grid

Support **job growth, manufacturing, and the circular economy** in a wide range of applications



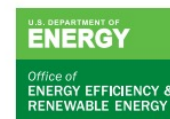
Solar Futures Study

PURPOSE

- Comprehensive review of the potential role of solar in decarbonizing the electricity grid by 2035 and the energy system by 2050.
 - Addresses other large trends and activities across the U.S. economy that are necessary to achieve a zero-carbon energy system.
 - Builds analytical foundations to guide the next decade of solar research.

SCOPE

- Chapters cover future scenarios, technology advances, equity, grid integration, cross-sector interactions, supply chain, and environmental impacts.



Solar Futures
STUDY



Solar Futures Study Summary

1 Deploy, deploy, deploy. An average of 30 GW of solar capacity per year to 2024 and 60 GW per year in 2025-2030. (The U.S. installed 15 GW in 2020.)

- 1 TW of solar meets 40% of electric demand in 2035, 1.6 TW meets 45% in 2050.
- Major growth in wind and storage are also required.

2 With continued technological advances, electricity prices do not increase through 2035. This includes solar, wind, energy storage, and other technologies.

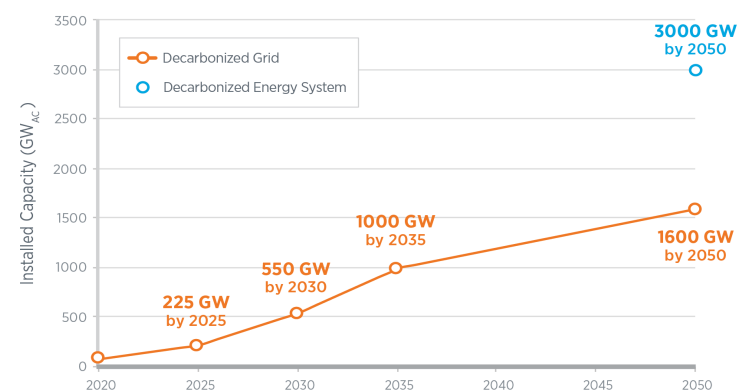
3 The grid will be reliable and resilient. Storage, transmission, and flexibility in load and generation are key.

4 Expanding clean electricity supply yields deeper decarbonization. Electrifying buildings, transportation, and industry reduces carbon emissions.

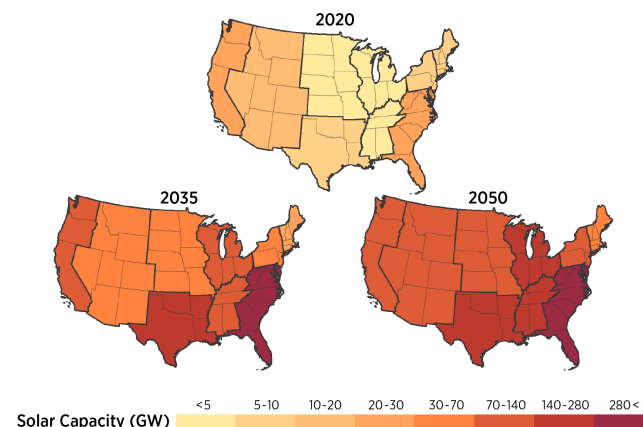
5 Policy changes are necessary. Limits on carbon emissions and/or clean energy incentives.

6 Challenges must be addressed so that solar costs and benefits are distributed equitably. Solar deployment can bring jobs, savings on electricity bills, and enhanced energy resilience.

Solar Deployment 2020–2050



Solar Capacity by Census Division in 2020, 2035, and 2050



Why interconnection and why ow?

*From 40 MW/day of new PV to 80-160MW/day within 13 -15 years
needs **2x/4x** faster Interconnection procedures*

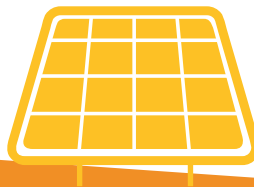
Zero-Carbon Future

Irreversible path to zero-carbon electricity system by 2035 is contingent on paradigm-shifts in interconnection practices to deploy clean energy technologies at exponential scales



Complexity

The modern grid is transforming rapidly, and grid Interconnection processes are growing ever more complex as penetrations levels increase and technologies advance



Equity

Inclusive and just transition. Broad group of stakeholders required to fully understand the regulatory, technical, and process challenges in interconnection



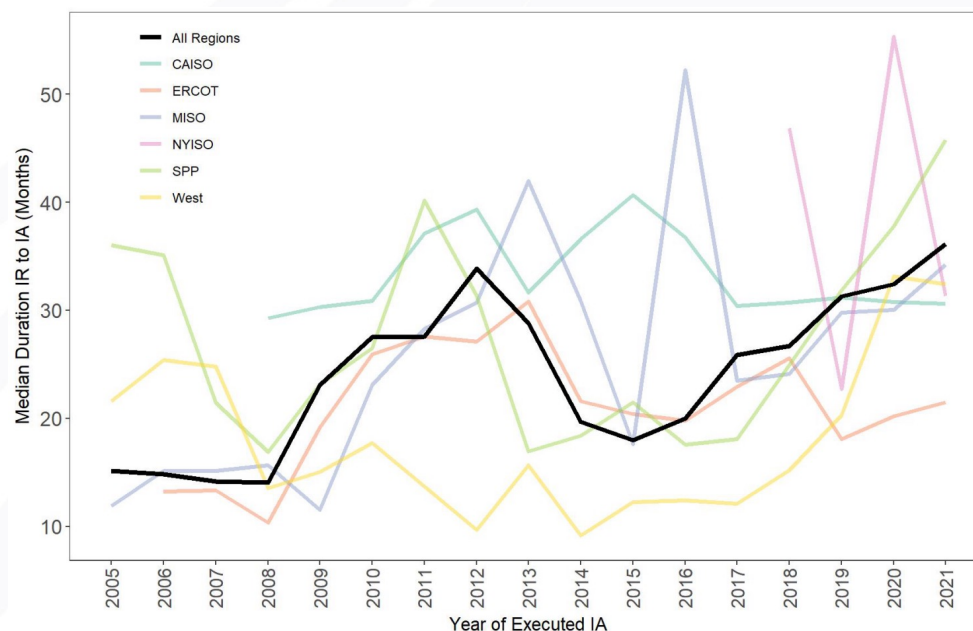
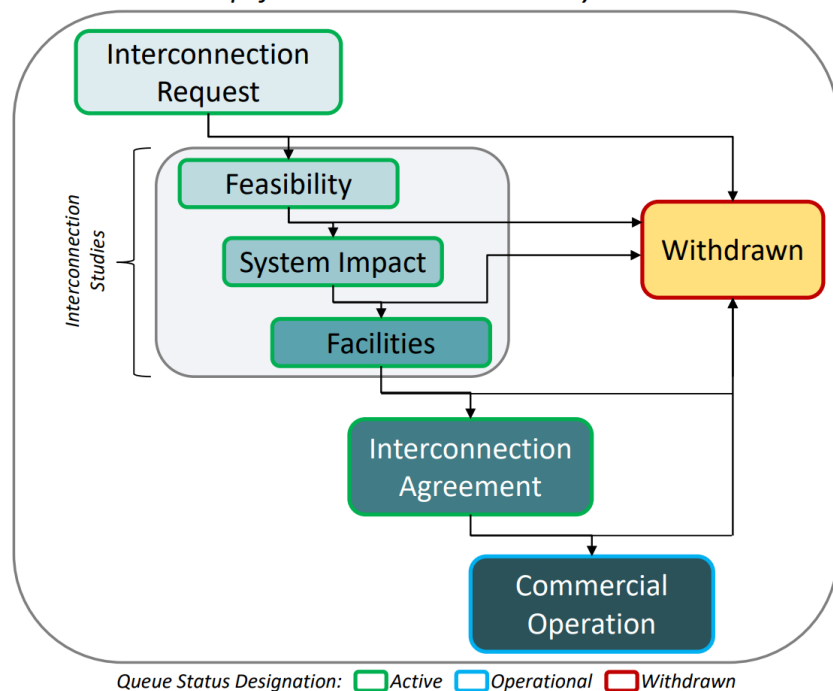
5x

Increase in the expected number of solar & wind deployments every year to meet 2035 targets

* Adapting Solar Futures Study findings of average +30GW/year (2020-2025) and +60GW/year (2025-2035) for solar

Interconnection queue times doubled since 2015

Simplified Interconnection Study Process



Source: Rand et. al., "Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2021", April 2022: <https://doi.org/10.2172/1864543>

Examples of difficult interconnection challenges

Limited Grid-Capacity
Transparency

Lengthy Queue
Processing
Timelines

Lack of Fair Cost
Allocation
Procedures

High Impact Study
Costs

High Complexity of
Interconnection
Application

Uncertainty in Cost
of System
Upgrades

Multi-Study
Timeline
Coordination
Issues

- Lack of hosting capacity analysis or similar tools linking land availability to interconnection capacity.
- High integration cost that are inconsistent with project size.
- Slow and cumbersome interconnection process can lead to off-takers opting out of community solar.
- Misalignment of interconnection application requirements with ability to bid community solar projects – requirements modified.
- Regulatory restrictions on interconnection timeline ensuring operation within 12-months or less.

i2X Key elements

Mission: To enable a **simpler, faster, and fairer** interconnection of clean energy resources while enhancing the **reliability, resiliency, and security** of our electric grid.



Stakeholder Engagement

Nation-wide engagement platform and collaborative working groups



Data & Analytics

Collect and analyze interconnection data to inform solutions development



Strategic Roadmap

Create roadmap to inform interconnection process improvements



Technical Assistance

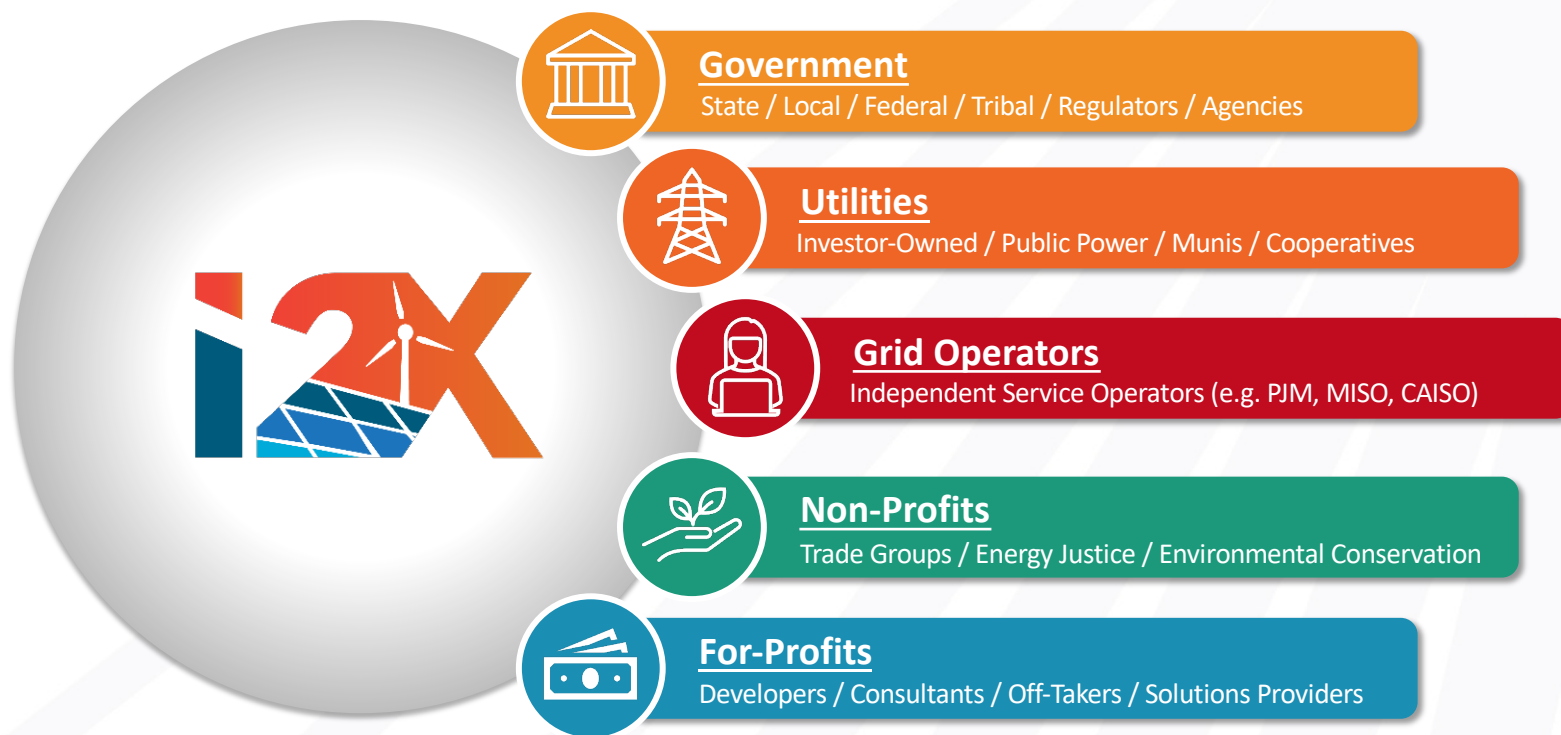
Leverage DOE laboratory expertise to support stakeholder roadmap implementation



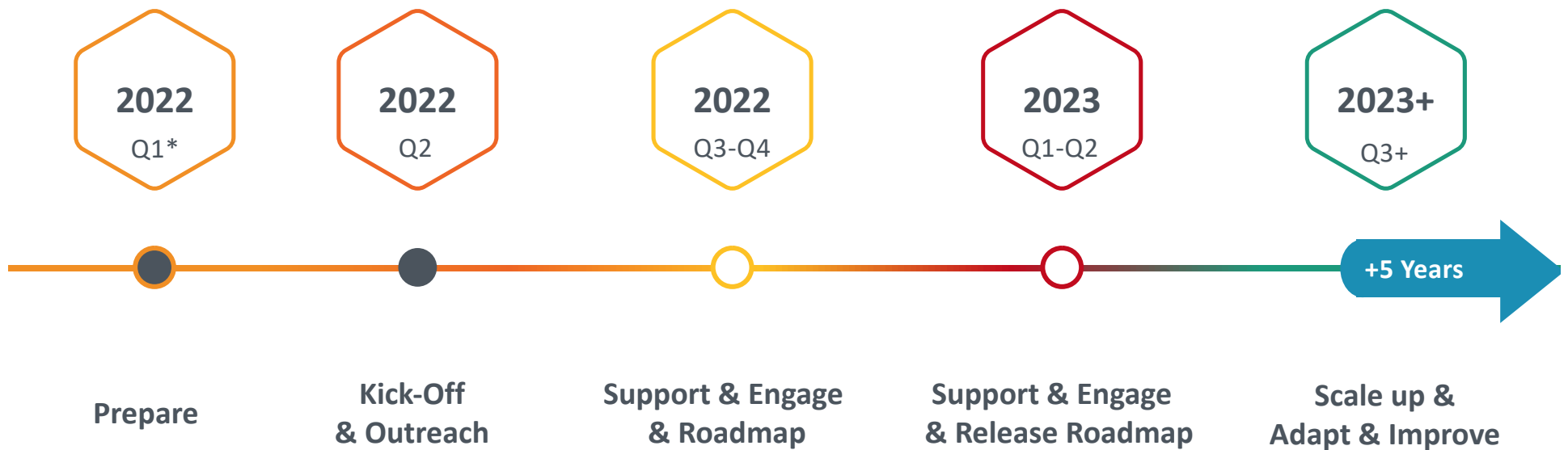
i2X Leadership team



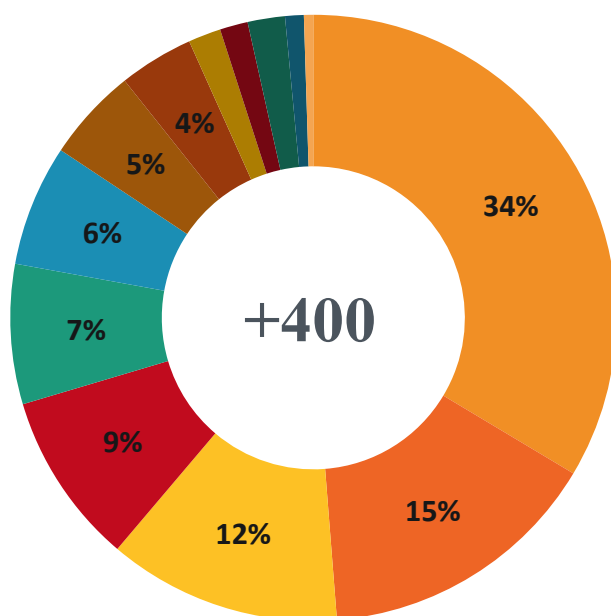
Diversity of engaged stakeholders is critical



i2X Program timeline



Your response to i2X has been incredible



Partner organization by sector

- Project Developer, EPC, or IPP
- Solutions Provider (e.g. software, tools, controls)
- Other (e.g. Consulting, Law Firms)
- Educational or Research Institute
- Electric Utility (e.g. IOU, Co-op, Muni)
- Government (Federal, State, Local, & Tribal)
- Energy Justice or Environmental Group
- Trade Association or Member Organization
- Energy Offtaker or Corporate Energy Buyer
- Advocacy & Policy Development
- Regulator (e.g. PUC)
- Independent System Operator
- Financial Institution or Energy Investments

Stay connected



VISIT OUR WEBSITE OR EMAIL US

Be sure to visit the i2X website
at www.energy.gov/i2x
Email us i2x@ee.doe.gov



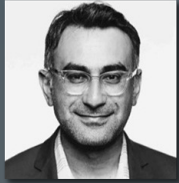
JOIN THE PARTNERSHIP

Join the growing list of i2X
partners to collaborate on
solving interconnection



ENGAGE & PARTICIPATE

Join our upcoming working
groups. Schedule an i2X
Office-Hour session



Presenter

Ammar Qusaibaty

Technology Manager
Solar Energy Technologies Office

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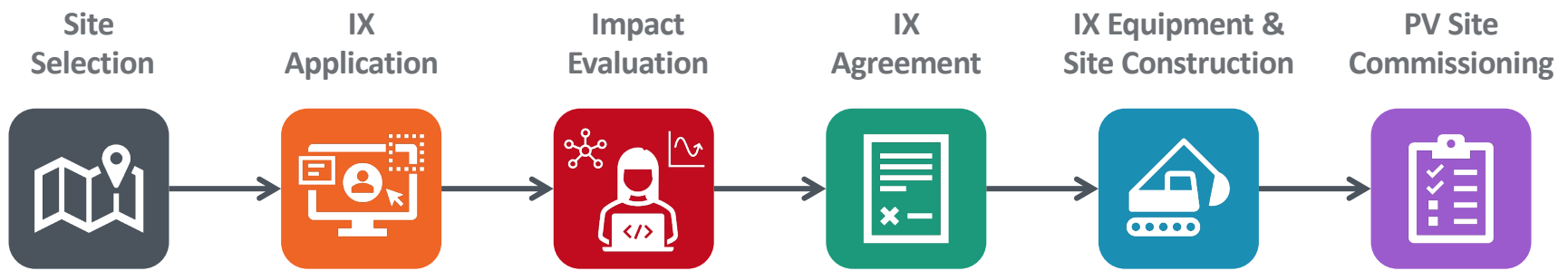
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Closing &
Networking
(15 min)

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How we think about Interconnection



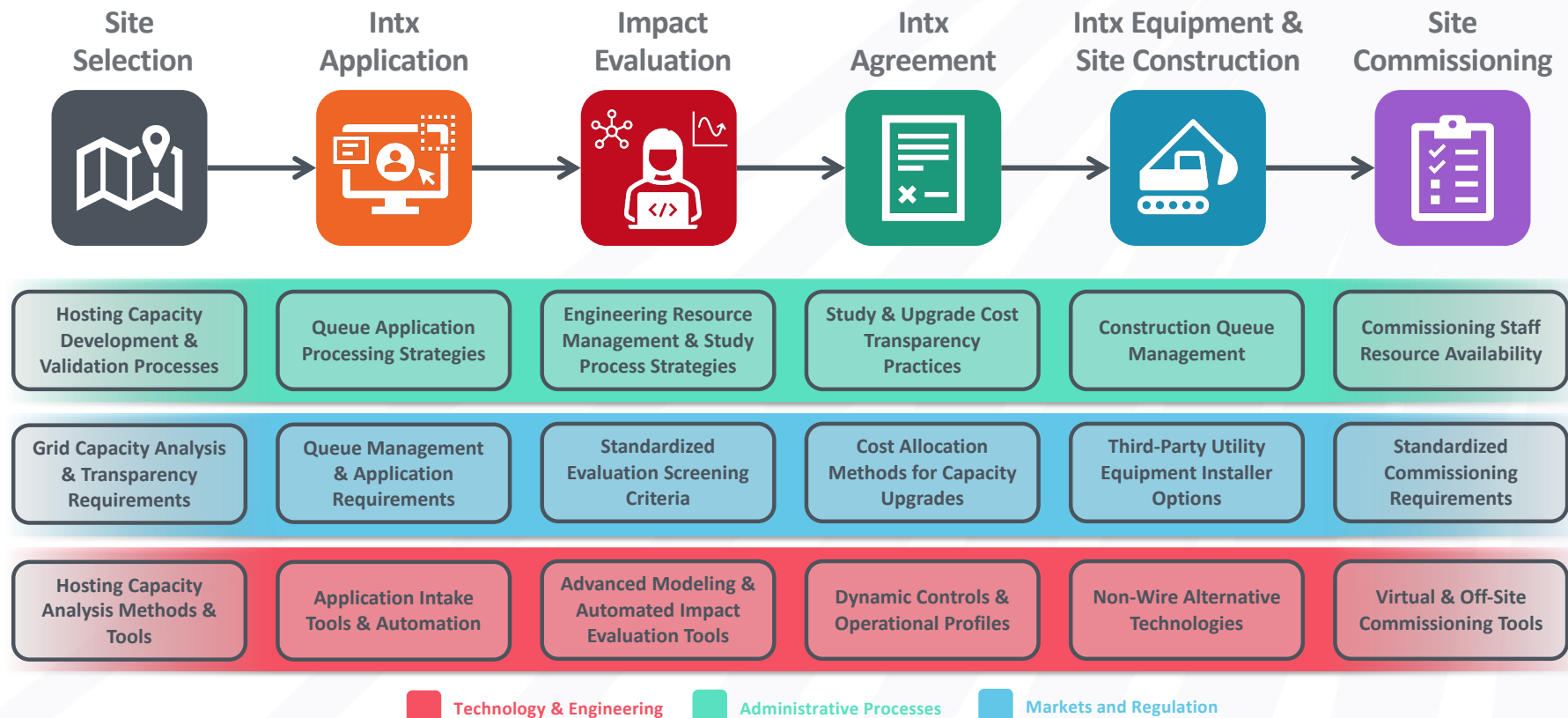
Administrative Processes

Markets and Regulation

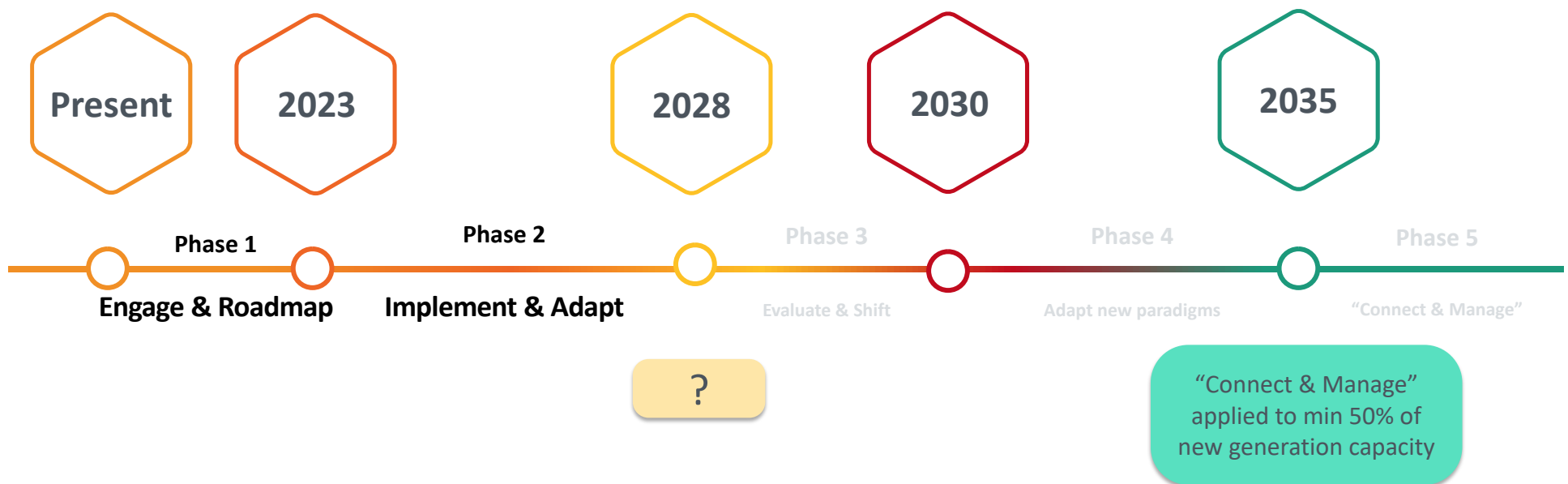
Technology & Engineering



Solutions and innovations (Today)



Interconnection Long View of Success



5-Year Strategic Roadmap

Goal: 50% cost and 50% schedule reduction in 5 years and transitioning to no more than 1-year from application to build going forwards

- Expert-Informed goal setting
- Success milestones & gaps to address
- Transparent key performance indicators
- Covers both DER & BPS and their interplay
- Customizations for size and region
- Covers challenging topics
- Stakeholder Actions. Multi-stakeholder actions
- Transition planning for new processes
- Buy-in, Adoption, and Updates



U.S. DEPARTMENT OF ENERGY
Building a Better Grid
National Transmission Planning Study

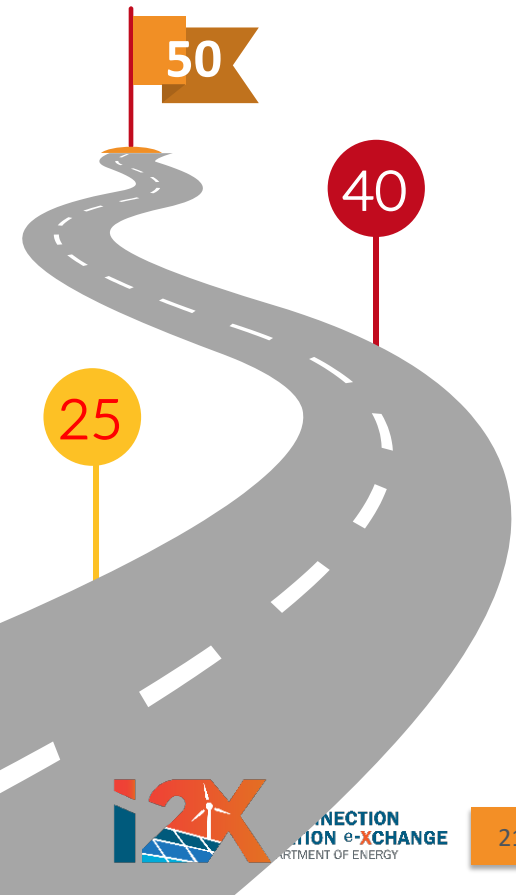


FERC NOPR RM22-14

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CONNECTION
e-**X**CHANGE
U.S. DEPARTMENT OF ENERGY



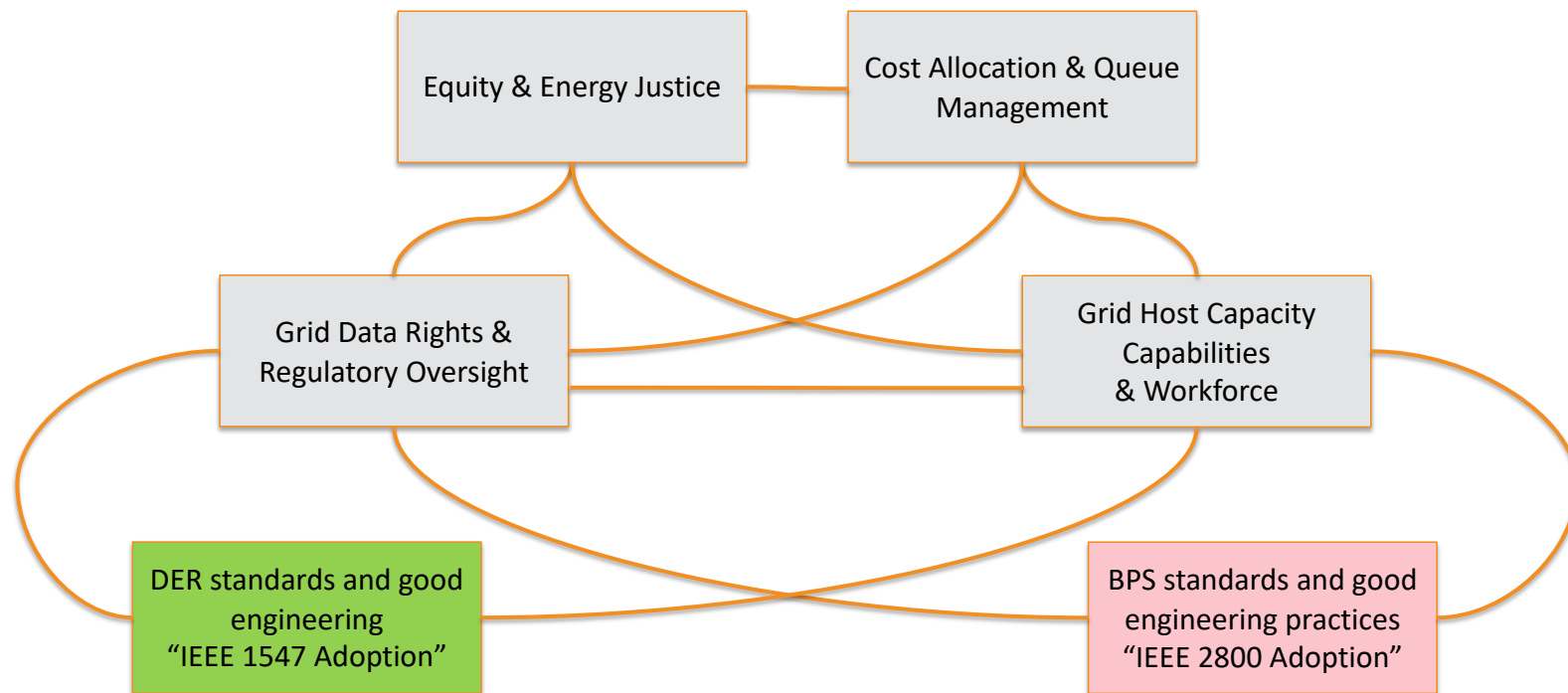
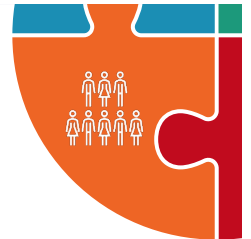
Roadmap Content

- Baseline for 2022 (post FERC's NOPR) showcasing the main challenges
- Discussion and justification of a target goal (e.g., a 50% goal) with other metrics including new metrics for equity and environment
- Yearly targets for metrics that show progress
- Data collection plan start-up and maintenance for measuring progress towards goal(s).
- Solutions and gaps in technology, standards, regulations, and policies
- How-to to implement solutions by developers, utilities, regulators, and customers in highly collaborative ways.
- Sprint studies of better queues and alternative queue
- Model improvements for new queue procedures and cost allocations
 - Include transitional periods
 - Include energy equity considerations beyond cost
- Pilots allowed within the FERC regulations and regulatory sandboxes in DERs
- References to supporting documents (e.g., Interconnection study guidelines)

Six Dimensions of Energy Equity

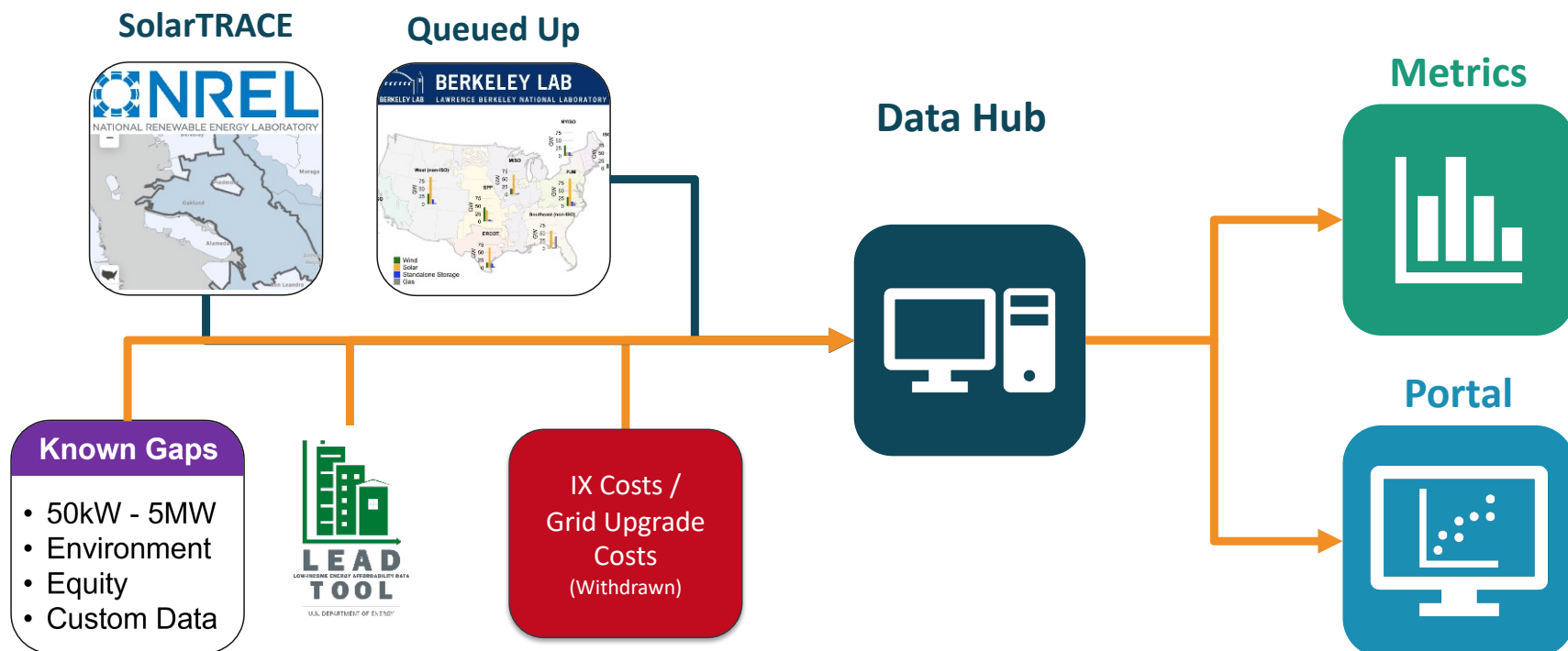
1. **Access** → e.g., eligibility for / participation in programs
2. **Affordability** → e.g., energy cost burden
3. **Decarbonization** → e.g., renewable energy target
4. **Environmental Impact** → e.g., air quality improvement
5. **Resilience** → e.g., sustained critical loads during extreme events
6. **Social Impact** → e.g., community ownership

Topics to cover in the Roadmap

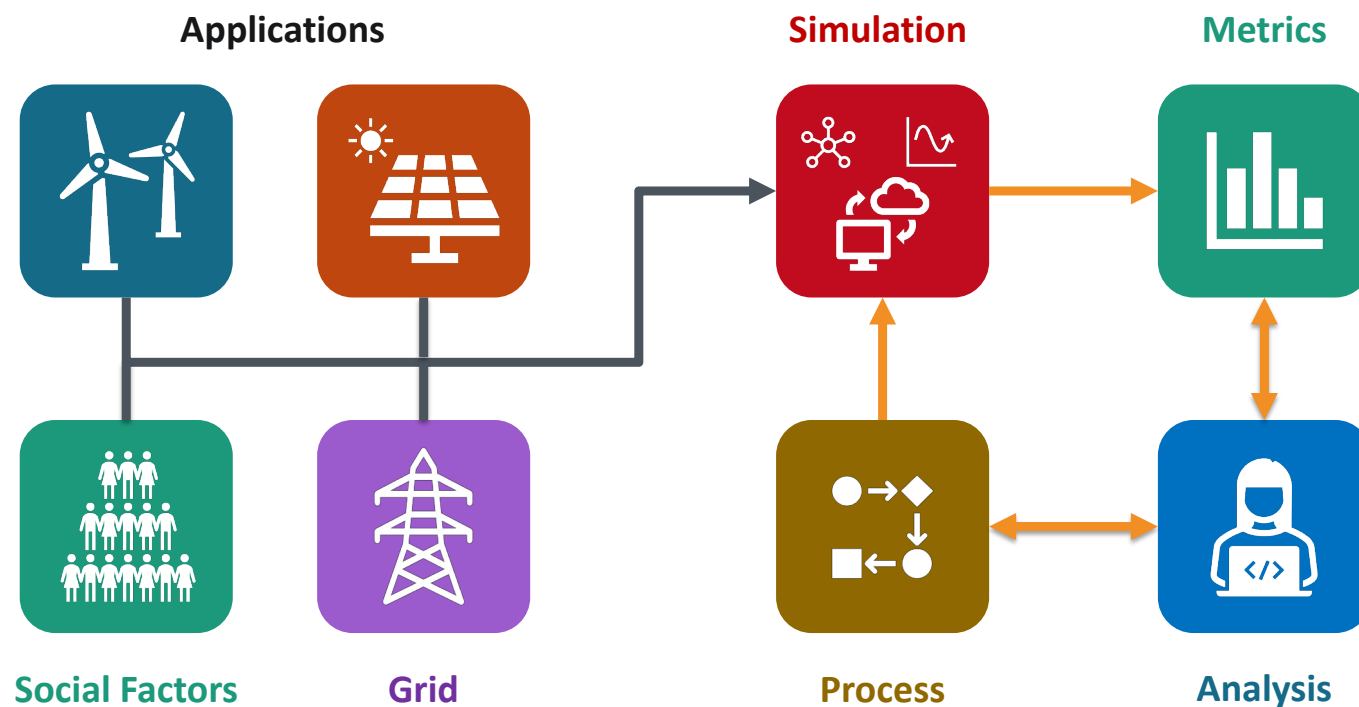


● DER Specific ● BPS Specific

Filling data gaps to support key metrics



Sprint studies with public data and tools



Two sprint studies with new metrics

A Better Queue

- Assume clusters per NOPR
- Incorporate new equity metrics
- Shared costs of system upgrades
- When is a project ready to proceed?
 - Site control and power purchase agreement
 - Financial payments to stay in queue
 - Project financing in place
- Cluster formation and management options
- Model building improvements
- Tool and re-study automation

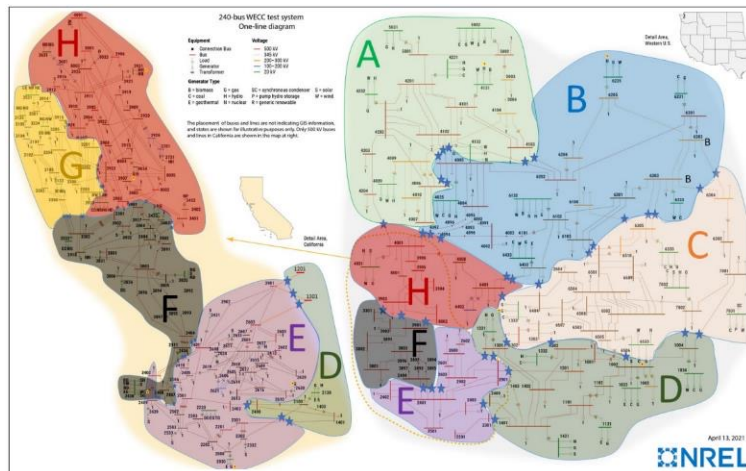
An Auction Process

- Discuss parallels to wideband spectrum auction
- Relationship between resource procurement processes, often under state jurisdiction, and interconnection processes under FERC jurisdiction
- Incorporate new equity metrics
- Identifying locations and quantities for new solar and wind resources
- Investing in renewable energy development zones (transmission)
- Requirements to participate
- Bid clearing mechanisms

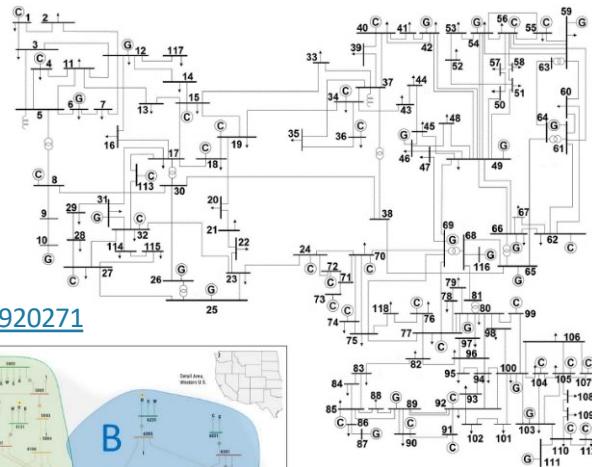
Public test systems for replicability

IEEE 118-Bus with IBR

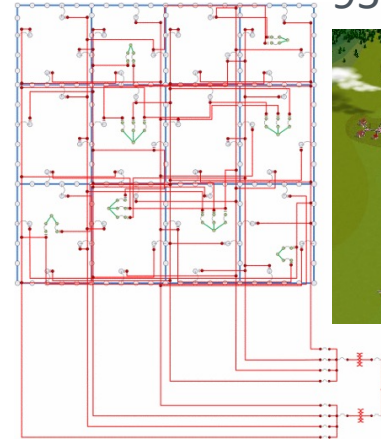
<https://doi.org/10.1109/TEM.C.2019.2920271>



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IEEE (proposed) 9500-node



IEEE Low-Voltage Network

<https://doi.org/10.1109/PESGM.2014.6939794>

WECC 240-Bus with IBR

<https://www.nrel.gov/docs/fy22osti/82287.pdf>



Technical Guide(s) to Interconnection Studies

Bulk Power Systems Guide

- Assumptions and Criteria
- Standards and Guidelines
- Data Collection
- When to use EMT Tools
- Model Development and Validation
- Analytical Steps and Automation
- Cluster Studies
- Re-study Criteria and Steps
- Post-Commissioning Models
- DER Aggregation
- Transmission Hosting Capacity
- Report Formats

Distribution System Guide

- Assumptions and Criteria
- Standards and Guidelines
- Data Collection
- When to use EMT (or Dynamics)
- Model Development and Validation
- Analytical Steps and Automation
- Hosting Capacity Studies
- DER Impact Studies
- Multi-DER (Feeder Cluster) Studies
- Influence of Storage and Chargers
- Report Formats





Questions

i2x@ee.doe.gov



Presenter
Karyn Boenker
Project Manager
Pacific Northwest National Laboratory

1

Welcome &
Introduction

2

5-Year Strategic
Roadmap Overview

3

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Closing &
Networking

Rules of Conduct for Interactive Discussion

1. Practice the Chatham House Rule. “Use discussion info freely and without attribution to individuals.”
2. Please use “Yes & ” to increase discussion flow.
3. Disagree and debate with respect.
4. Remember that diverging views show a bigger picture.
5. Please self-edit as needed. Encourage others to speak up.

Conceptualizing Fairer, Faster, Simpler

"i2X is focused on developing innovative solutions to enable the faster, simpler, and fairer interconnection of solar energy, wind energy, and energy storage to the electric grid while enhancing the reliability and resiliency of our nation's distribution and transmission grid networks."

Discussion:

- What synonyms do you associate with *fair*, *fast*, and *simple* in the context of interconnection?
- Are there priorities that should be edited or added to the mission?

Framing: Getting on the same page

Which “solutions” would you categorize as “fairer,” “faster,” or “simpler” ways to go about renewable interconnection?

Split into tables of 5-6 people and start placing solution examples under the most appropriate category. Feel free to write your own examples as well! Example solutions include:

- Cost reduction goals
- Time reduction goals
- Equal treatment/benefit goals
- 50% reduction in time
- Reduced interconnection fees
- Rate-based system upgrades
- Queue cluster management
- Auctions of interconnection capacity
- Incentive programs
- Fast track processing
- Additional utility IX headcount
- Public capacity maps
- Public demography maps
- Public resiliency maps
- Standardization
- Certification
- Pre-approved equipment lists

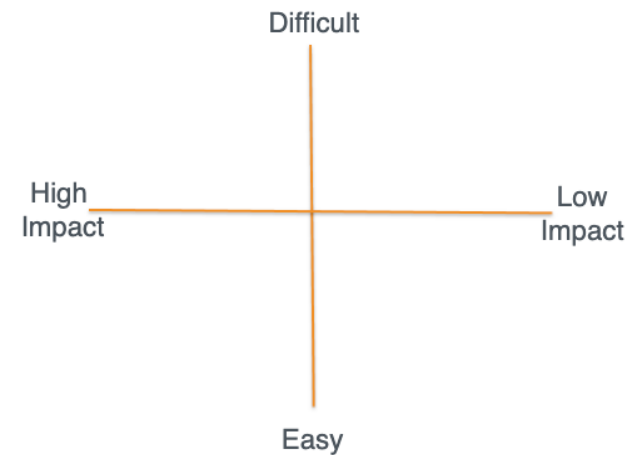
Discussion: Analyzing our opinions

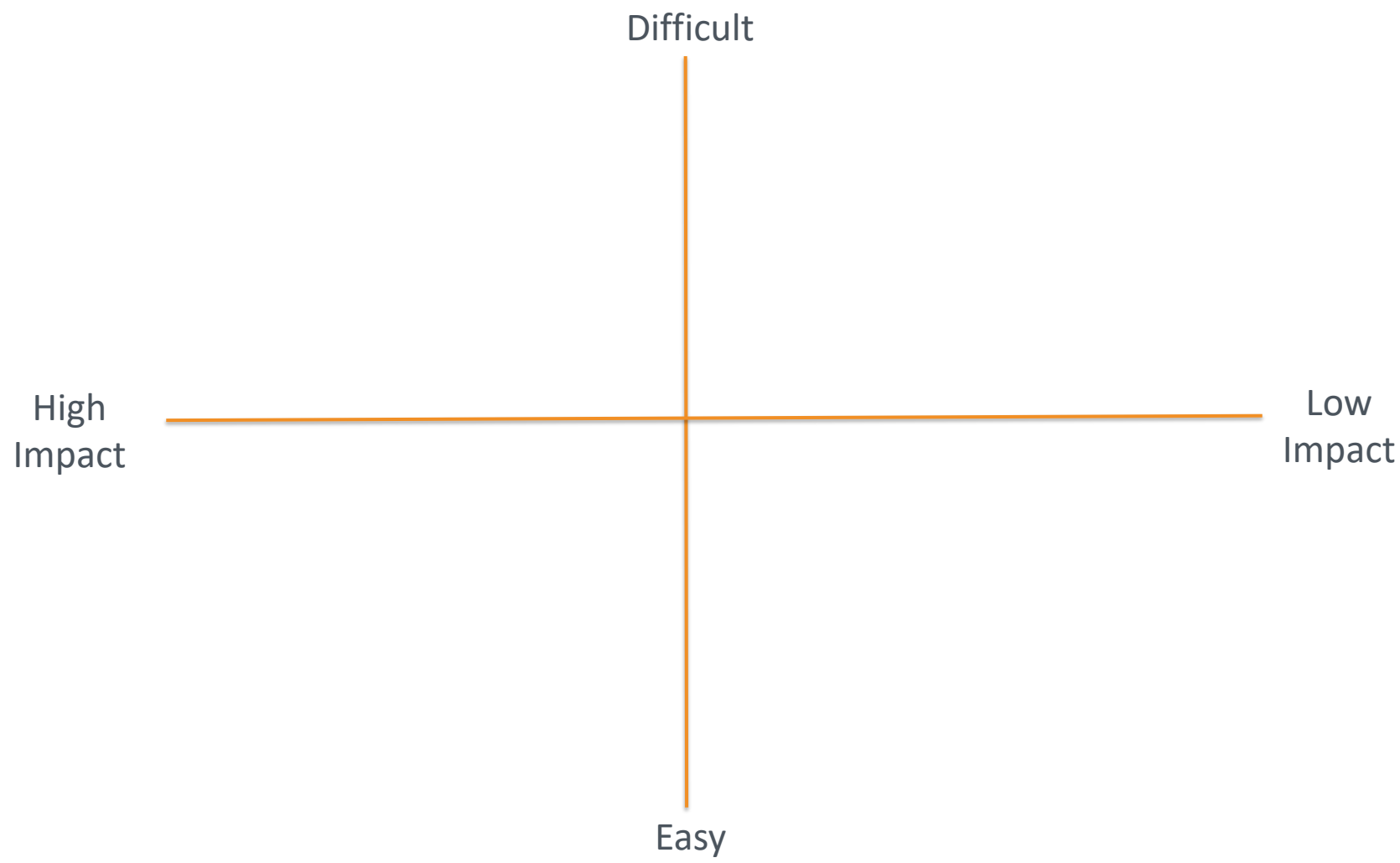
Discuss the difficulty of achieving the identified solutions.

Place sticky notes on the scale of "easy to difficult" vs "low to high impact" and prepare to explain your team's choices.

Consider the following barriers:

- Time and pathway to achieve reform
- Cost to achieve reform for utility, contractor, or ratepayer
- Regulatory barriers
- Political or perceptual barriers
- Who can lead the solution





Share your thoughts on what's next for i2X

- **Topical Working Groups**
 - Do we need more or less working groups?
 - What topics or tech focus are we missing?
 - Which working groups you like to join or form?
- **Technical Assistance**
 - What kind of technical assistance will be necessary?
 - What topics must the i2X team have expertise in?
 - What kind would be the most helpful?
- **Data Collection**
 - What kind of data do we need to collect and analyze?
 - What have or can you provide overtime?
 - Which audiences need to see our data?

Email

i2x@ee.doe.gov

Schedule a 20-min
i2X Office Hour



**INTERCONNECTION
INNOVATION e-XCHANGE**
U.S. DEPARTMENT OF ENERGY

Thank You!

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